Serial No.: 09/677,284

Amendments to the Specification

Please replace the paragraph beginning at Page 2, line 11 with the following amended paragraph:

The problem of decoding borehole telemetry signals is unusual in that the bandwidth is a large fraction of the carrier frequency, the bit rate is very low, and the signal to noise ratio is poor at the limits of range. Phase shift keying is well known, and it has long been known that the optimal means, from a signal to noise point of view, to transmit binary data over a noisy channel is to utilize 180-degree phase shifts. Phase shift is defined with respect to a constant frequency carrier. The transmitted data consists of a string of binary bits with which a time period (window) for each bit is associated. Fig. 1 is illustrative of phase shift keyed modulation. Shown is a phase shift keyed waveform, a carrier and the binary bits being transmitted. As shown, time is divided into windows, one for each bit. The ~~sine~~ sign of the waveform changes ~~sine~~ sign if the bit changes. A "1" corresponds to the case where the signal has the same phase as the carrier, while a "0" is transmitted by sending the signal with a phase 180 degrees away from that of the carrier. Correct demodulation of the phase shift keyed signal requires that the carrier and windows be known.

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Please replace the paragraph beginning at Page 3, line 3 with the following amended paragraph:

One known approach to the decoding of phase shift keyed signals is based upon a phase locked loop (PLL). Use of a phase locked loop in phase shift keyed decoding is complicated by the fact that the phase is reversed when the bits change. Thus, the signal must be multiplied by the demodulated bit so that it always has the same ~~sine~~ sign as the carrier before being fed to the phase locked loop. This is shown in Fig. 4. Using the known decoder shown in Fig. 4, the error signal is mixed with the oscillator output with 90-degree phase shift added. When the circuit is locked onto a signal, the error signal is very small and reflects small deviations of the oscillator from a perfect phase match. This error signal is filtered and fed into the voltage controlled oscillator (VCO) in order to maintain the lock. A second channel with the carrier not phase shifted is used to obtain the bit values. The binary bit stream can be obtained by means of a ~~compariter~~ comparator to determine the ~~sine~~ sign of the signal. This method has the obvious problem that the bits are needed to demodulate the signal and to maintain lock, but the bits cannot be obtained before lock is attained. Such a method works well for tracking a signal once the phase locked loop is locked onto it; however, circuits of this kind are poor at acquiring lock and can be unlocked by noise.

Please replace the paragraph beginning at Page 7, line 7 with the following amended paragraph:

The essence of this invention is that one can calculate a set of possible data streams, one for each of several possible transmitter time bases and then pick the best one according to criteria of signal strength and data integrity. Fig. 3 is a diagram showing synchronization and decoding of phase shift keyed signals in accordance with the method of this invention. As shown therein, a signal is fed into a set of channels which are identical except that phase shifts are added to the carrier and corresponding time delays which indicate the start of new windows. In each channel, the signal is first multiplied by the phase-shifted carrier to partially demodulate it. The signal is then averaged, or integrated, over the window. At the end of the window, the average is read out and the integrator is reset to zero. Because the bit values are bipolar, the squares of the bit values are used to indicate the best fits. A running average of the squares is maintained for a preceding time period and the bit stream corresponding to the largest running average is selected for generating the final bit stream. The final bit stream is usually going to be obtained from the bit values by using a ~~compariter~~ comparator to detect the ~~sine~~ sign of the value. In some implementations, especially when there are only a small number of candidate bit

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values, the decoded stream can be optimized by varying the oscillator phase and the window timing.

Please replace the paragraph beginning at Page 8, line 2 with the following amended paragraph:

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Figs. 2a and 2b show the actual values of the running averages versus time delay based on theoretical and experimental data, respectively. The rapid oscillations in the averages are due to the change in relative phase between the carrier and the phase of the candidate bit value carrier. The maximal value of the sum occurs when the candidate windows are the same as the actual window. The theoretical curves assume a very large number of sample points with a random distribution of bit values. The curves obtained from real signals will depart from the theoretical averages due to the presence of noise and the fact that they are sums over a finite set of windows. The actual data will influence the shape of the curves. In some cases, it may not be clear which maximum is best, and in this case, the data integrity can be used to select the best bit stream. In essence, error correcting codes and checksums will often be used and this allows one to measure the bit error rate. It should also be noted that the ~~sine~~ sign of the carrier depends upon the relative orientations of the

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transmitter and the receivers and may need to be determined by looking at the bit error rates.

Please replace Table 1 on Page 10 of the specification with the following amended Table 1:

Table 1. Signal Strengths and Bit Error Rates

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Depth (ft.)	Signal Strength (measured) (pT)(μV)	Signal Strength Without Casing (pT)(μV)	Error Rate
1260	1.05	2.57	0.5%
1112	1.4	4.0	1%
964	2.2	6.5	0.3%
815	4.0	11.2	0.3%